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Project Report

PA-229-5
(RSP)

Data Reduction Program Documentation
ALT10

(Effective: April 1971)

C. R. Berndtson
R. H. French
D. E. Nessman

19635

7 April 1971

Prepared for the Advanced Research Projects Agency,
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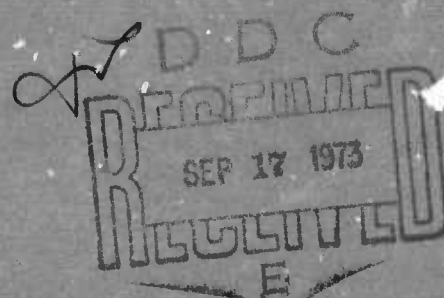
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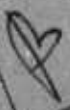


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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

DATA REDUCTION PROGRAM DOCUMENTATION

ALT10

(EFFECTIVE: APRIL 1971)

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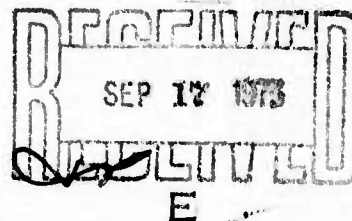
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PROJECT REPORT PA-229-5 (RSP)

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FOREWORD

This is the fifth report in the Data Reduction Program Documentation series. It is dated according to the date of completion of the documentation. No implication is made that this program will not subsequently be modified, amended, or superseded; on the contrary, the history of radar data processing is one of continuous evolution of techniques, and it is unrealistic to assume that steady-state has been reached. The PA-229 series is being published for the convenience of interested parties, and Lincoln assumes no responsibility for the correctness of the information presented, nor for its currency.

The preparation of reports in this series is under the Editorship of Charles R. Berndtson of Lincoln, and of D. Nessman and R. French of Philco-Ford Corporation. Inquiries, suggestions, corrections, criticisms, and requests for additional copies should be directed to C. R. Berndtson.

The principal contributor to this report was J. R. Cornelius (Philco-Ford). Due to the intricate, evolutionary manner in which the programs came into being, the editors regret that it is in general impossible to give due credit to all-- mathematicians or radar analysts or programmers -- who contributed to the definition and writing of the programs.


Alan A. Grometsstein

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COMMON SYMBOLS AND ABBREVIATIONS

(The units given for certain quantities are the units commonly used for those quantities, unless otherwise noted.)

ADT	ALCOR Data Tape
Alt	Altitude (km)
APS	Average Pulse Shape
ARS	ALTAIR Recording System
Avg	Average, Averaging
Az	Azimuth (deg)
CADJ	Adjusted Calibration Constant (db)
C-band	ALCOR frequency, 5664 MHz (NB) and 5667 MHz (WB)
El	Elevation (deg)
EOF	End of File
GMT	Greenwich Mean Time
h	Hours
Hz	Hertz
in	Inches
LC	Left Circular Polarization
min	Minutes
NB	Narrow Band
NRTPOD	Non-real Time Precision Orbit Determination Program
POD	Project PRESS Operation and Data Summary Report
Phase	Presented in deg
PRF	Pulse Repetition Frequency (pps)
PRI	Pulse Repetition Interval (s)
pps	Pulses per second
pts	Points
R	Range (km)
\dot{R}	Range Rate (km/s)
rad	Radians
RC	Right Circular Polarization
RCS	Radar Cross Section (dbsm)
s	Seconds
SD_w	Standard Deviation of Wake Velocity

T	Time
TAL	Time After Launch (s)
UHF	ALTAIR Frequency; 415 MHz
V	Velocity
V_d	Doppler Velocity
V_w	Mean Wake Velocity
VHF	ALTAIR Frequency; 155.5 MHz
WB	Wide Band
θ	Total Off-axis Angle (deg)
λ	Wavelength
*	Denotes Multiplication

FLOW DIAGRAM SYMBOLS



PROCESS, ANNOTATION



DECISION



TERMINATOR



SUBROUTINE: where NAME is the entry call into the subroutine



CONNECTOR: where P specifies a page in the flow diagram, and L designates a statement number in the program listing or a reference point in the flow diagram



CONNECTOR: where X implies a continuation of the diagram to the next page



INPUT/OUTPUT OPERATION



MAGNETIC TAPE



PUNCHED CARD



DISK

ALT10

I. PURPOSE AND UTILIZATION

A. Source of Data

ALTAIR¹

B. Data Input

ALTAIR transcription tape

C. Description

ALT10 is used primarily to produce plots of peak ~~RCS vs TAL.~~

radar cross sections *time after launch.*
The program also produces plots of ~~RCS~~ in selected range gates vs ~~TAL~~.

D. Output

1. A listing of pertinent identification data.
2. Plots vs TAL of peak RCS and of RCS in selected range gates.

radar cross sections vs time after launch.

II. DESCRIPTION

ALT10 averages the RCS data in each range gate every 0.05 s, and searches the gates to find the peak RCS. It then plots peak RCS vs TAL. A plot of the RCS in each of the range gates is also produced.

The data cards are not checked for validity. Subroutine ALREAD² makes a number of checks on transcription tape parameters. For some errors (missing format tables; end of file; target no., sampling pattern, or polarization not on tape) information is returned to main program for decision to terminate.

III. OPERATION

A. Input

Start and stop times (GMT)

Specified set of range gates

Target and sampling pattern numbers

Polarization

A sample input is shown in Appendix A.

CARD 1 (15A4)

Col. 1-16 Label for plots and listing

Col. 17-60 Additional labels for listing

CARD 2 (2I3, F7.3, 2I3, F7.3, 4X, 4I5)

Col. 1-3 IH1 (I3)

Col. 4-6 IM1 (I3)

Col. 7-13 ZSEC1 (F7.3)

Col. 14-16 IH2 (I3)

Col. 17-19 IM2 (I3)

Col. 20-26 ZSEC2 (F7.3)

Col. 31-35 NRG

Col. 36-40 INTARG

Col. 41-45 IPAT

Col. 46-50 IPOL

Col. 51-55 ING**

Start time (GMT) in h, min, and s

Stop time (GMT) in h, min, and s

Number of range gates (I5)

Target no. (I5)

Sampling pattern in which initial gate is located

Data channel: 1 = LC; 2 = RC; 3 = Az error*;
4 = El error* (I5)

The location within IPAT of initial gate (I5)

*VHF transcriptions only.

**Called ISTGAT in ALREAD.

B. Output

LISTING

Title

Target no. , frequency, and polarization

Start and stop times (GMT total seconds)

Identification of gate being plotted

Identification of peak gate being plotted

PLOTS

RCS vs TAL (abscissa is 4 s/in, ordinate is + 40 to - 60 dbsm at
20 db/in)

Sample outputs are given in Appendix B.

IV.

PROGRAM LIMITATIONS

Start time	Must be on tape
Stop time	Must be on tape
NRG	≤ 120
INTARG	Must be on tape
Length of run	≤ 300 s

V. PROGRAMMING

A. ALT10 (see Appendices C and D).

ALT10 is the control section of ALT10. ALT10 reads the input cards, calls ALREAD, and averages the data returned. ALT10 also calls the plot routines, and prints the data.

B. ALREAD²

ALREAD is the Fortran driver for the machine language tape reading routines.

The call statement is ALREAD (TSTART, TSTOP, TLIFT, INTARG, INPAT, IPOL, NOPHA, NPTS, DFPG, NEWPAS, NRG, ISTGAT).

INPUT

TSTART	Start time of processing (GMT total seconds)
TSTOP	End time of processing (GMT total seconds)
INTARG	Target number to be processed
INPAT*	Sampling pattern in which initial gate is located
NRG	Number of range gates to be processed
ISTGAT**	Location within INPAT of initial gate wanted
NOPHA	1 (only RCS data wanted)
IPOL	Data channel: 1 = LC; 2 = RC; 3 = Az error; 4 = El error

INPUT AND OUTPUT PARAMETERS

NPTS [†]	Output: number of pulses of data returned Input: must be initialized by calling program before each call to ALREAD
NEWPAS ^{††}	Cycle and error pointer

*Also called IPAT.

**Also called ING or ISG.

[†]Set to zero for first call. Set to number of saved points for subsequent calls.

^{††}Also called IAGAIN.

OUTPUT

TLIFT	Lift-off time (GMT total seconds)
DFPG	Frequency and polarization (e.g. VHF LC)

STORED IN COMMON

TIMES	Pulse times (GMT total seconds)
XSPHA	RCS and phase for each pulse and gate
RANGKM	R
ALSAV*	Alt
IRGA	Range gate array associated with XSPHA
NFPG	Frequency code: 1 = VHF; 2 = UHF

C. REW

REW is an entry to subroutine BREADS³ used to rewind the tape.

D. PLOTEN

PLOTEN plots RCS vs TAL for every gate and for the peak gate.

E. Plotting System Subroutines

They are REREAD, STOIDV, and PLTND.

*Valid for first pulse of minor cycle. It is repeated for subsequent pulses.

REFERENCES

1. "ALTAIR Data User's Manual", LM-97, Lincoln Laboratory, M.I.T. (to be published), UNCLASSIFIED.
2. "Data Reduction Program Documentation, ALREAD, (Effective: March 1971)", PA-229-3, Lincoln Laboratory, M.I.T. (17 March 1971), UNCLASSIFIED.
3. "Data Reduction Program Documentation, ALTAIR Tape Read Package, (Effective: April 1970)", PA-229-1, Lincoln Laboratory, M.I.T. (17 March 1971), UNCLASSIFIED.

ALT10 INPUT

CARD 1

CARD 2

IBM 50-6118

APPENDIX B
ALT10 OUTPUTS

ALTAIR LINK 10 VERSION DATE 9 OCTOBER 1970
FLP 1J03 ALT10 G108

TIME FROM 34418.0200 TO 34428.5000 TARGET 46 VHF-LC

```

RANGE GATE      1 IS NOW PLOTTING
RANGE GATE      2 IS NOW PLOTTING
RANGE GATE 12345 IS NOW PLOTTING
THE PEAK IS IN GATE 2 FROM 1708.7110 TO 1709.2110
THE PEAK IS IN GATE 1 FROM 1709.2610 TO 1709.2610
THE PEAK IS IN GATE 2 FROM 1709.3110 TO 1709.7610
THE PEAK IS IN GATE 1 FROM 1709.8110 TO 1709.8110
THE PEAK IS IN GATE 2 FROM 1709.8610 TO 1711.6610
THE PEAK IS IN GATE 1 FROM 1711.7110 TO 1711.7110
THE PEAK IS IN GATE 2 FROM 1711.7610 TO 1713.0610
THE PEAK IS IN GATE 1 FROM 1713.1110 TO 1713.1610
THE PEAK IS IN GATE 2 FROM 1713.2110 TO 1713.4110
THE PEAK IS IN GATE 1 FROM 1713.4610 TO 1713.4610
THE PEAK IS IN GATE 2 FROM 1713.5110 TO 1714.2610
THE PEAK IS IN GATE 1 FROM 1714.3110 TO 1714.3610
THE PEAK IS IN GATE 2 FROM 1714.4110 TO 1714.8110
THE PEAK IS IN GATE 1 FROM 1714.8610 TO 1714.9610
THE PEAK IS IN GATE 2 FROM 1715.0110 TO 1715.0110
THE PEAK IS IN GATE 1 FROM 1715.0610 TO 1715.2610
THE PEAK IS IN GATE 2 FROM 1715.3110 TO 1715.5610
THE PEAK IS IN GATE 1 FROM 1715.6110 TO 1715.6610
THE PEAK IS IN GATE 2 FROM 1715.7110 TO 1715.7110
THE PEAK IS IN GATE 1 FROM 1715.7610 TO 1715.8610
THE PEAK IS IN GATE 2 FROM 1715.9110 TO 1715.9610
THE PEAK IS IN GATE 1 FROM 1716.0110 TO 1716.0610
THE PEAK IS IN GATE 2 FROM 1716.1110 TO 1716.1110
THE PEAK IS IN GATE 1 FROM 1716.1610 TO 1716.3110
THE PEAK IS IN GATE 2 FROM 1716.3610 TO 1716.4110
THE PEAK IS IN GATE 1 FROM 1716.4610 TO 1716.5610
THE PEAK IS IN GATE 2 FROM 1716.6110 TO 1716.6610
THE PEAK IS IN GATE 1 FROM 1716.7110 TO 1716.9110
THE PEAK IS IN GATE 2 FROM 1716.9610 TO 1717.0610
THE PEAK IS IN GATE 1 FROM 1717.1110 TO 1717.1110
THE PEAK IS IN GATE 2 FROM 1717.1610 TO 1717.1610
THE PEAK IS IN GATE 1 FROM 1717.2110 TO 1717.4610
THE PEAK IS IN GATE 2 FROM 1717.5110 TO 1717.6610
THE PEAK IS IN GATE 1 FROM 1717.7110 TO 1718.3110
THE PEAK IS IN GATE 2 FROM 1718.3610 TO 1718.3610
THE PEAK IS IN GATE 1 FROM 1718.4110 TO 1718.5610
THE PEAK IS IN GATE 2 FROM 1718.6110 TO 1718.6610

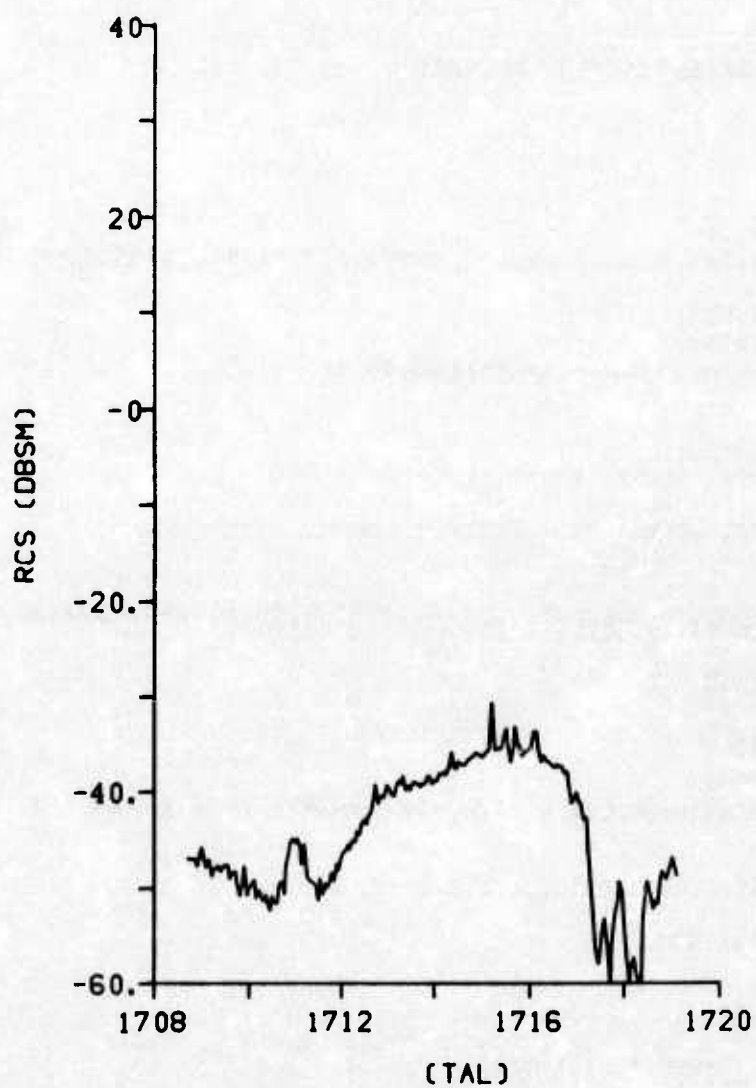
```


ELP 1J03 ALT10

TARGET 46

PEAK GATE

VHF-LC



APPENDIX C
ALT10 PROGRAM LISTING

```

DIMENSION AVXS(120),DFPG(2),IPGATE(6000),PEAKXS(6000),PLOTAG(15),
1 SINK(120),TPLT(6000),XSPLT(6000)
DOUBLE PRECISION SEC,T1,T2,TIMES,TLIFT,TOTIM,TOUT,TPLT,TSBV,
1 TSTART,TSTOP,ZSEC1,ZSEC2
COMMON/RDCOMT/TIMES(300),XS(120,300),RANGE(300),ALT(300),IRGA(120)
1,NFPG
EQUIVALENCE (TPLT(1),XS(1,1)),(XSPLT(1),XS(1,151)),
1(PEAKXS(1),XS(1,201)),(IPGATE(1),XS(1,251))
DATA AVXS/120*0.0/
DATA TINC/0.05/
TOTIM(IH,IM,SEC)=DFLOAT(60*(60*IH+IM))+SEC
CALL REREAD(99,540)
TSTOP=0.0
IAGAIN=0
READ(5,40) PLOTAG
40 FORMAT(15A4)
CALL STOIDV(PLOTAG,59,0)
60 READ(5,80,END=900) IH1,IM1,ZSEC1,IH2,IM2,ZSEC2,NRG,INTARG,IPAT,IPOL
1,ING
80 FORMAT(2(2I3,F7.3),4X,5I5)
TSTART=TOTIM(IH1,IM1,ZSEC1)
IF((TSTART.GT.TSTOP).AND.(IAGAIN.NE.44)) GO TO 90
CALL REW
IAGAIN=1
90 TSTOP=TOTIM(IH2,IM2,ZSEC2)
NPTS=0
NREC=0
KOUNT=0
T1=TSTART
T2=T1+TINC
100 CALL ALREAD(TSTART,TSTOP,TLIFT,INTARG,IPAT,IPOL,1,NPTS,DFPG,IAGAIN
1,NRG,ING)
IF(IAGAIN.EQ.55) GO TO 900
IF(IAGAIN.EQ.66) GO TO 60
IF(NPTS.NE.0) GO TO 160
120 IF(NREC.NE.0) GO TO 500
WRITE(6,140) IH1,IM1,ZSEC1
140 FORMAT('1 AT TIME = ',I2,I3,F8.4,' NO VALID POINTS WERE FOUND - R
1 UN HAS BEEN ABORTED.')
```

IAGAIN=49
GO TO 60

```

160 DO 400 J=1,NPTS
IF(T1.GT.TIMES(J)) GO TO 400
KOUNT=KOUNT+1
DO 200 I=1,NRG
XSQM=10.0** (XS(I,J)/10.0)
AVXS(I)=AVXS(I)+XSQM
200 CONTINUE
IF(T2.GT.TIMES(J)) GO TO 400
IF(KOUNT.LE.0) GO TO 240
COUNT=KOUNT
DO 220 I=1,NRG
AVXS(I)=10.*ALOG10(AVXS(I)/COUNT)
IF(I.EQ.1) GO TO 210
IF(AVXS(I).LE.PEAK) GO TO 220

```

```

210  IPGAT=IRGA(I)
      PEAK=AVXS(I)
220  CONTINUE
      TOUT=T1-TLIFT
      WRITE(4) TOUT, IPGAT, PEAK, (AVXS(I), I=1, NRG)
      NREC=NREC+1
      IF(NREC.GT.6000) GO TO 500
240  DO 260 I=1, NRG
      AVXS(I)=0.0
260  CONTINUE
      T1=T2
      T2=T1+TINC
      KOUNT=0
      IF(T2.GT.TSTOP) GO TO 500
      IF(T2.LE.TIMES(NPTS)) GO TO 400
      IF(IAGAIN.EQ.0) GO TO 120
      NPTS=NPTS-J
      DO 280 K=1, NPTS
      JK=J+K
      TIMES(K)=TIMES(JK)
      RANGE(K)=RANGE(JK)
      ALT(K)=ALT(JK)
      DO 280 L=1, NRG
      XS(L,K)=XS(L,JK)
280  CONTINUE
      GO TO 100
400  CONTINUE
      IF(IAGAIN.EQ.0) GO TO 120
      NPTS=0
      GO TO 100
500  REWIND 4
      WRITE(6,520) PLOTAG,TSTART,TSTOP,INTARG,DFPG
520  FORMAT('1'/8X,'ALTAIR LINK 10 VERSION DATE 9 OCTOBER 1970'/2X,
115A4//2X,'TIME FROM ',F10.4,' TO ',F10.4,6X,'TARGET ',I3,2X,2A4//)
      DO 700 I=1, NRG
      DO 660 J=1, NREC
      IF(I.NE.1) GO TO 600
      READ(4) TPLT(J), IPGATE(J), PEAKXS(J), XSPLT(J)
      GO TO 660
600  KIN=1
      KOUT=I-1
      READ(4) TPLT(J), IPGATE(J), PEAKXS(J), (SINK(K), K=KIN, KOUT), XSPLT(J)
660  CONTINUE
      REWIND 4
      CALL PLOTEN(TPLT, XSPLT, NREC, DFPG, IRGA(I), INTARG, PLOTAG)
700  CONTINUE
800  NDRG=12345
      CALL PLOTEN(TPLT, PEAKXS, NREC, DFPG, NDRG, INTARG, PLOTAG)
      TSAV=TPLT(1)
      ISGAT=IPGATE(1)
      NOUT=0
      DO 840 I=2, NREC
      IF(IPGATE(I).EQ.ISGAT) GO TO 820
      WRITE(6,820) ISGAT, TSAV, TPLT(I-1)
820  FORMAT(' THE PEAK IS IN GATE ',I3,' FROM ',F11.4,' TO ',F11.4)
      ISGAT=IPGATE(I)
      TSAV=TPLT(I)
      NOUT=NOUT+1
840  CONTINUE
      IF(NOUT.EQ.0) WRITE(6,820) ISGAT, TPLT(1), TPLT(NREC)
      IAGAIN=49
      GO TO 60
900  CALL PLTND
      RETURN
      END

```

APPENDIX D
ALT10 FLOW DIAGRAM

